AUTOTRANSFORMER-TYPE STARTERS
ALLEN-BRADLEY COMPANY
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.001 This addendum supplements Section 026-343-701, Issue 1.

1.002 This addendum is issued to specify the use of KS-19578 L1 trichloroethane wherever KS-8372 trichloroethylene is now specified. The same precautions that apply for KS-8372 trichloroethylene shall apply to the KS-19578 L1 trichloroethane.

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ALLEN-BRADLEY COMPANY
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1. GENERAL

1.01 This section covers the following starters manufactured by the Allen-Bradley Company.

KS-15664	KS-15855
KS-15665	KS-15856
KS-15782	

1.02 Reference shall be made to Section 020-010-711 covering general requirements and definitions for additional information necessary for the proper applications of the requirements listed herein.

1.03 ***Phi (Φ):*** Requirements are marked with a phi when they are not required to be checked before turnover.

1.04 ***Asterisk (*):*** Requirements are marked with an asterisk when to check for them would necessitate dismantling or dismounting of apparatus, or would affect the adjustment involved, or other adjustments. No check need be made for these requirements unless the apparatus or part is made accessible for other reasons, or its performance indicates that such a check is advisable.

1.05 In the text the word ***relay*** is used to denote contactor or control relay, unless specific mention of either is required.

1.06 For the purpose of this section, contacts are normally open (NO) or normally closed (NC) depending on their position when no operating current is flowing through the coil and not on their normal position for a particular application which may involve continuous operating current through the coil under normal circuit conditions. NO and NC contacts are sometimes referred to as front and back contacts, respectively.

1.07 ***Operate:*** A relay is said to operate if, when current is connected to its winding, the armature moves sufficiently to meet the following conditions.

(a) All normally open contacts close and all normally closed contacts open.

(b) The armature rests against the core.

1.08 ***Release:*** A relay is said to release when the armature has moved sufficiently for NO contacts to open and NC contacts to close with reliable contact.

1.09 ***Nonoperate:*** A relay is said to nonoperate when, with current flowing through the coil, the armature has not moved sufficiently for NO contacts to close or to reduce the pressure of NC contacts enough to cause unreliable contact.

1.10 ***Precautions Against High Voltage:*** The voltage should be removed from the terminals before performing any work on the relay or checking requirements other than electrical or temperature requirements. If the relay operates in an automatic control circuit, before work is started on the relay the automatic control should be made inoperative as described in the appropriate section covering the apparatus.

1.11 Relays should not be handled by the contact springs.

1.12 Where the construction is such that adjustments or other procedures are not practicable, failure to operate satisfactorily should be corrected by replacing the appropriate parts or the entire unit.

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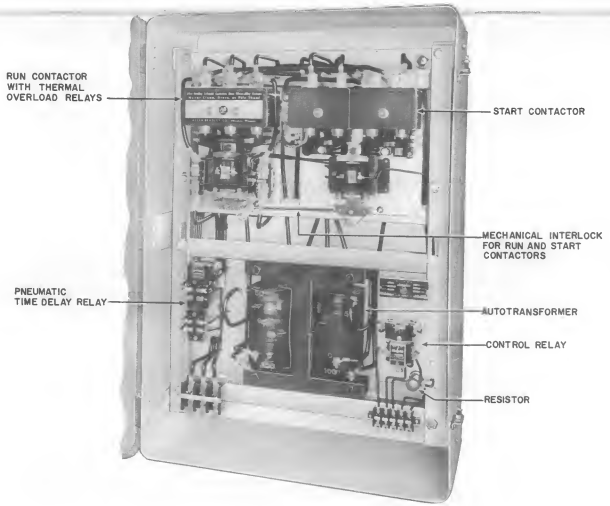

Fig. 1 — KS-15664 Starters — Typical 20 Horsepower Unit Shown

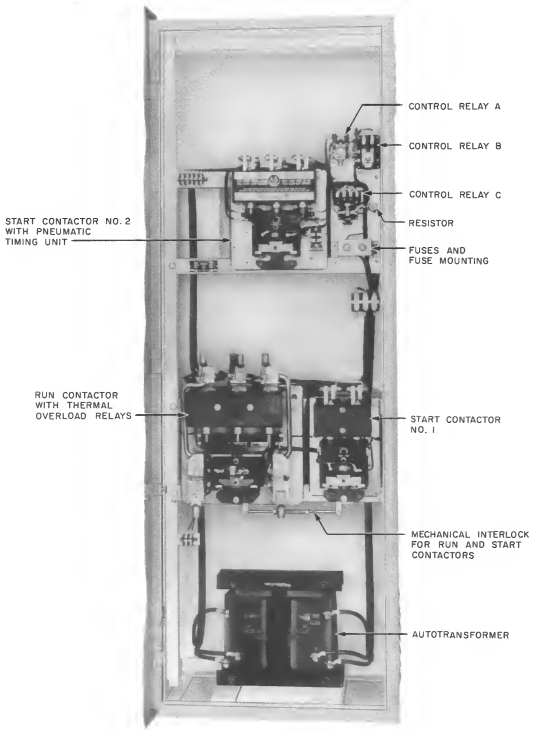
CONTROL RELAY A
CONTROL RELAY B
CONTROL RELAY C
RESISTOR
FUSES AND FUSE MOUNTING
START CONTACTOR NO. 2 WITH PNEUMATIC TIMING UNIT
RUN CONTACTOR WITH THERMAL OVERLOAD RELAYS
START CONTACTOR NO. 1
MECHANICAL INTERLOCK FOR RUN AND START CONTACTORS
AUTOTRANSFORMER

Fig. 2 — KS-15856 Starters — Typical 75-Horsepower Unit Shown

2. REQUIREMENTS

Φ2.01 *Mounting:* The relay shall be fastened securely to its mounting. Fastenings holding components together shall be secure.

Gauge by feel.

Caution: Do not touch or short-circuit live terminals or parts.

2.02 *Cleaning Contacts and Removing Build-ups:* Contact surfaces shall be clean and free from build-ups which might interfere with reliable contact.

Gauge by eye.

*2.03 *Allen-Bradley Contactors and Control Relays*

(a) *Contact Pressure and Follow:* For the main contacts, the contact pressure shall be adequate if the movable contact support (cross bar) moves minimum 1/8 inch, after the contacts make.

Gauge by feel.

To check the requirement, close the contactor or relay slowly by hand, observing the distance the support can move after the contact is first made.

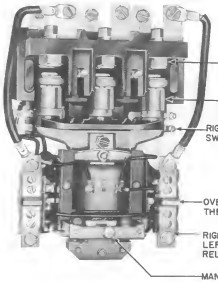
FRONT AND REAR STATIONARY CONTACTS
CROSS BAR MOVABLE CONTACT ASSEMBLY
RIGHT HAND AUXILIARY SWITCH
OVERLOAD RELAY THERMAL ELEMENT
RIGHT HAND AND LEFT HAND OVERLOAD RELAYS
MANUAL RESET

Fig. 3 — Typical Run Contactor With Arc Hood Cover Removed

Struthers-Dunn Control Relays (Requirements 2.04 through 2.08)

2.04 *Contact Alignment:* Contacts of the same diameter shall be so aligned that when the contacts are closed, the outer edge of one contact does not extend over the outer edge of the other more than

Max 1/32 inch

2.05 *Contact Sequence:* All NO contacts shall make at approximately the same time.

Gauge by eye.

2.06 *Contact Separation:* The separation between mating contacts when open shall be

Min 5/32 inch

Use the R-8550 scale.

2.07 *Contact Pressure:* The pressure between closed contacts shall be

Min 50 grams

Use the No. 79C gauge.

To check the requirement for NO contacts, hold the armature firmly against the pole face with the KS-6320 orange stick, taking care not to touch the contact springs. Apply the finger of the gauge to the movable contact spring as near to the contact as practicable and exert pressure with the gauge away from the stationary contact. Read the gauge when the contacts just open.

2.08 *Freedom of Operation of Armature:* The armature shall move freely throughout its travel.

Gauge by feel.

To check the requirement, slowly operate the armature manually with a KS-6320 orange stick.

2.09 *Bulletin 849, Style AX Pneumatic Time-Delay Relay and Bulletin 896 Timing Mechanism*

(a) The time-delay interval shall be adjusted in accordance with requirement 2.11.

Note: The Bulletin 896 timing mechanism used in conjunction with start contactors is also a part of the Bulletin 849 relay.

2.10 ***Electrical Requirements***

(a) The relay shall meet the electrical requirements specified in the circuit requirements table or other job information.

(b) Where electrical requirements are not specified in the circuit requirements table, operation of a relay shall be checked at the minimum coil voltage specified on the nameplate, where the operating voltage is expressed as a range. Where a nominal value is given, check at a value which is 10 per cent less than the nominal.

(c) Check of electrical requirements may be at the temperature at which the relay is found unless H (hot) or C (cold) is specified in the circuit requirements table.

(d) Where H is specified in the circuit requirements table without heating instructions, the relay coil shall be energized for at least 1 hour prior to the test.

(e) Where C is specified in the circuit requirements table without cooling instructions, the relay shall be de-energized for at least 2 hours prior to the test.

(f) Where requirements are in volts, it is direct current unless otherwise specified, and a 35-type test set arranged for reading volts or a 35-type test set, not so arranged, supplemented by a dc voltmeter should be used. Where test set preparation has not been specified in the circuit requirements table, it is suggested that both relay coil terminals be disconnected and both battery and ground be furnished through the test set with B G V or B G preparation.

(g) Where electrical requirements are expressed in volts alternating current, connect the ac supply to the input of a continuously tapped autotransformer. Connect the relay coil and a voltmeter across the output of the autotransformer and adjust to the specified value.

2.11 ***Time-Delay Interval Adjustment***

(a) With the line voltage at its average value, the voltage supplied by the ***autotransformers*** to the motor which is being started shall be such as to bring the motor to approximately full speed, within approximately the following interval without blowing the supply fuses.

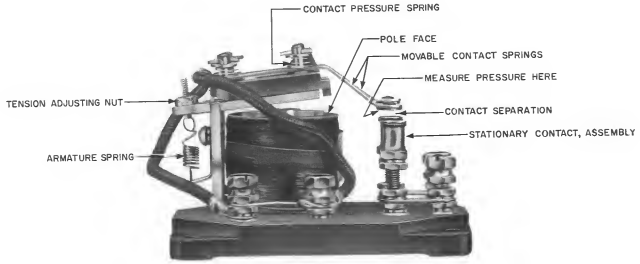

Fig. 4 — Struthers-Dunn Control Relay

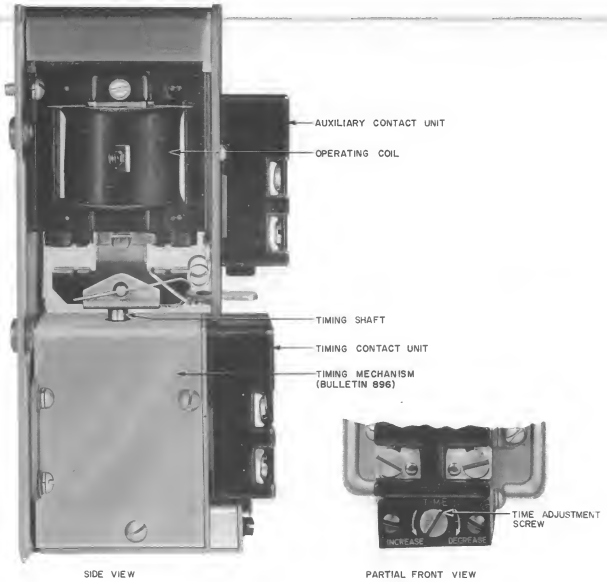

Fig. 5 — Pneumatic Time-Delay Relay — Bulletin 849, Style AX

MOTOR RATING HP	SECONDS
15 to 30	10
31 to 40	15
41 to 75	20

Use watch or clock.

(b) The delay interval shall be adjusted so that the motor which is being started is transferred smoothly but without excessive delay, from the starting taps on the autotransformer in the starters to the line, at any line voltage within the office range.

Gauge by sound.

*2.12 *Temperature:* The temperature rises of the various parts above an ambient temperature between the limits of 10 C and 40 C shall not exceed the following values.

	MAXIMUM RISE ABOVE AMBIENT
Operating Coils	
Class A insulation	65 C (149 F)
Class H insulation	85 C (185 F)
Contacts (measured at the terminals for contactors)	75 C (167 F)
Autotransformer Windings	85 C (185 F)
Resistors	250 C (482 F)

Use a thermometer.

If the temperature is thought to be excessive, check as follows. Hold the bulb of the thermometer against the hottest spot in question, covering the part of the bulb not in contact with the part being measured by a pad of asbestos. Observe the highest temperature indicated after it has stabilized.

Caution: Various parts reach temperatures at which it is dangerous to touch them.

3. ADJUSTING PROCEDURES

3.001 ***List of Tools, Gauges, Materials, and Test Apparatus***

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
373D	Contact Burnisher Holder
374A	Burnisher Blade
417A (2 reqd)	1/4- by 3/8-inch Hex. Open Double-End Flat Wrench
KS-6320	Orange Stick
KS-6015	Duckbill Pliers
KS-14208 (2 reqd)	Brush
R-1542	6-inch Single-End Adjustable Wrench
—	Long-Nose Pliers
—	4-inch E Screwdriver
GAUGES	
79C	0-200 Gram Push-Pull Tension Gauge
KS-14510, List 1	Volt-Ohm-Milliammeter
R-8550	6-inch Steel Scale
—	—10 C to +400 C Thermometer, Fisher Scientific Co No. 14-985
MATERIALS	
KS-8372	Stabilized Trichloroethylene
KS-14666	Cleaning Cloth
—	Asbestos Pad
—	1-ounce Bottle

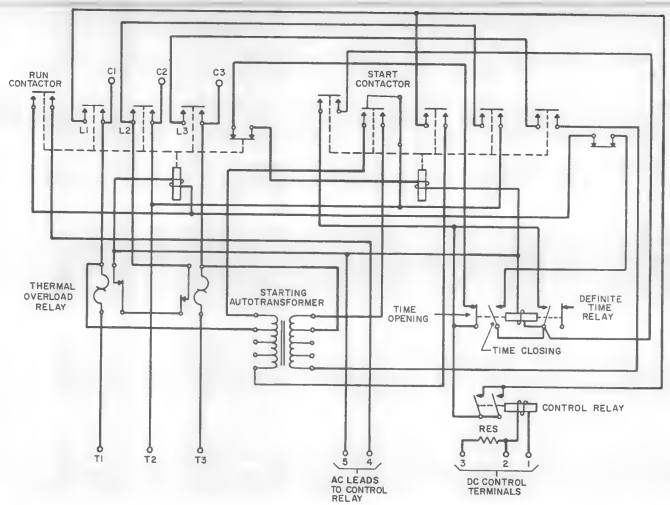

Fig. 6 — KS-15664, Lists 1 to 6, and 11 to 16 AC Starter Schematic

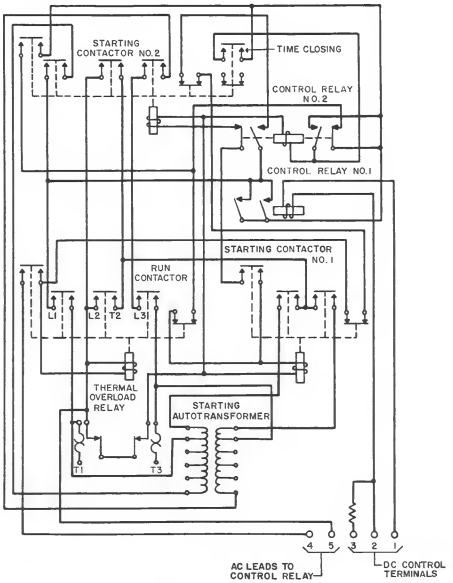

Fig. 7 — KS-15665, Lists 1 to 6 AC Starter Schematic

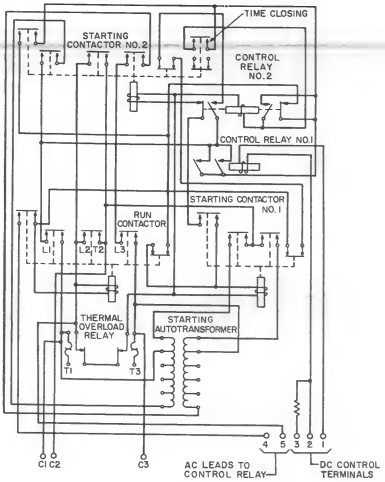

Fig. 8 — KS-15782, Lists 1 to 6 AC Starter Schematic

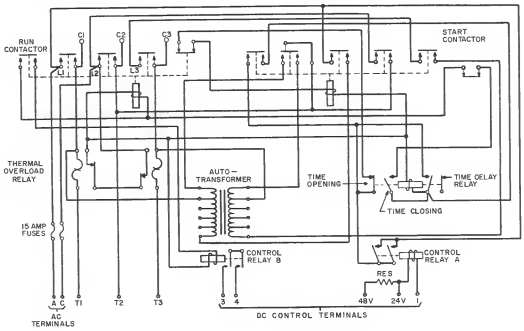

Fig. 9 — KS-15855, Lists 1 to 6 Starter Schematic

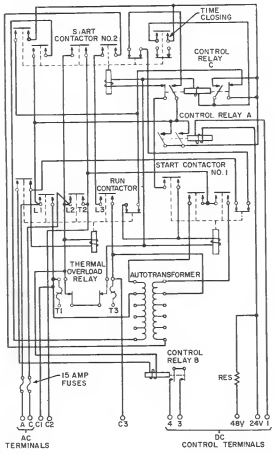

Fig. 10 — KS-15856, Lists 1 to 6 Starter Schematic

CODE OR SPEC NO.	DESCRIPTION
TEST APPARATUS	
35 Type	Test Set
—	Autotransformer, Continuously Tapped (Variac, 2-ampere, 230-volt input, type W-5, HMT, provided with overload protector, or equivalent; General Radio Company, Cambridge, Mass. suggested)

3.01 ***Mounting*** (Reqt 2.01)

(1) Tighten loose mounting screws and terminal nuts.

3.02 ***Cleaning Contacts and Removing Build-ups*** (Reqt 2.02)

(1) ***General***

(a) Before cleaning contacts or removing build-ups, disconnect the power supply from the contacts. (Refer to 1.10.)

Caution: Be sure to disconnect the power supply before removing the arc hood covers of the contactors. Never operate starters with covers removed.

(b) Silver contacts of the contactors and relays must be replaced before the silver is completely gone. Do not file or use sandpaper on the contacts as it only results in a loss of silver and a reduction of life. Clean as in (2) or smooth with a burnisher as in (3). If build-ups are excessive, the contacts should be replaced.

(c) Replace contacts which are badly worn. When replacing worn movable contacts of a control relay, or elsewhere when necessitated by the construction, install a complete contact spring.

(2) ***Cleaning Contacts:*** To remove dirt and gummy substance, clean the contacts with KS-8372 trichloroethylene as covered in (a) and (b) and then brush them with a dry, clean KS-14208 brush as covered in (c).

(a) Pour a small quantity of the trichloroethylene into a 1-ounce bottle. It is important to avoid the use of contaminated trichloroethylene in cleaning the contacts. Therefore, discard the trichloroethylene as soon as it appears slightly dirty.

(b) Dip the hairs of a clean KS-14208 brush their full length in the trichloroethylene. Remove excess fluid by wiping the brush on the edge of the bottle. Then, with the pair of contacts open, brush the entire surface of the contact to be cleaned with the moist brush.

(c) Brush the contacts with a dry, clean KS-14208 brush.

(3) ***Removing Build-Ups:*** There shall be as little smoothing of contacts as is consistent with satisfactory operation. Contacts should be smoothed while closed, where practicable. To remove build-ups, use the No. 374A burnisher blade held in the No. 373D contact burnisher holder. Insert the blade between the contacts and move it back and forth until the build-ups are reduced enough to insure reliable contact. Exercise care to avoid reducing the height of the contact. After burnishing, brush the contacts with a dry KS-14208 brush.

3.03 ***Allen-Bradley Contactors and Control Relays*** (Reqt 2.03)

(1) In general, correction for lack of contact pressure and follow involves the replacement of badly worn contacts and weak contact springs.

(2) The contacts of the contactors and relays may be cleaned as covered in 3.02. The instruction relative to the contacts, "Never clean, etc" which appears on some nameplates refer to the use of a file. If any of the contacts should require replacement, replace the entire set.

Struthers-Dunn Control Relays
(Procedures 3.04 through 3.08)

3.04 ***Contact Alignment*** (Reqt 2.04)

(1) Adjust slightly misaligned contact springs with the KS-6015 pliers. Badly bent movable contact springs (movable contact fingers)

should be removed and reshaped if practicable or otherwise replaced as covered in Section 026-343-801.

(2) If satisfactory contact alignment cannot be obtained, replace the relay.

3.05 ***Contact Sequence*** (Reqt 2.05)

(1) If the requirement is not met, check the stationary and movable contacts as a group. Adjust misaligned movable springs with the KS-6015 pliers. Adjust the height of stationary contacts using one or two No. 417A wrenches, as required. Recheck the requirement and also check requirements 2.04, 2.06, 2.07, and 2.09.

3.06 ***Contact Separation*** (Reqt 2.06)

(1) To adjust contact separation, loosen the locknut of the stationary contact using one or two No. 417A wrenches, as required. Turn the stationary contact assembly as required, and tighten the locknut. Do not bend the movable contact spring. Recheck the requirement and also check requirements 2.04, 2.05, 2.07, and 2.09.

3.07 ***Contact Pressure*** (Reqt 2.07)

(1) Contact pressures are specified on a minimum basis and have a direct bearing on the electrical requirements. If the pressure is greatly in excess of the specified minimum limit, the relay may fail to meet its electrical requirements. After changing contact pressure, check requirement 2.05.

(2) To change the contact pressure of NO contacts, adjust the height of the stationary contacts using one or two No. 417A wrenches as required.

3.08 ***Freedom of Operation of Armature*** (Reqt 2.08)

(1) Remove any foreign matter which may have lodged between the armature and pole face of the coil with the KS-6320 orange stick. In some cases, the armature or pole face may require cleaning with KS-8372 trichloroethylene on a KS-2423 cloth wrapped around the orange stick.

3.09 ***Bulletin 849, Style AX Pneumatic Time-Delay Relay and Bulletin 896 Timing Mechanism*** (Reqt 2.09)

(1) Adjustment of the time period is provided by a needle valve adjustment screw in front of the timing mechanism. Turning the screw clockwise decreases the time period, counterclockwise increases the time period. To determine the initial and final setting, refer to 3.11.

3.10 ***Electrical Requirements*** (Reqt 2.10)

(1) A check of the operation of a voltage-rated relay is made by connecting a voltmeter across the coil terminals. If there is no reading on the voltmeter, a study of the associated circuit is necessary to find whether the absence of voltage indicates a circuit fault, or is a condition to be overcome by blocking a relay or otherwise changing circuit conditions. Failure to operate with rated voltage at the coil terminals may sometimes be corrected by readjustment, but in some cases, it may be due to an open coil. To check for an open coil, connect the voltmeter in series with the operating voltage and the coil. No reading on the voltmeter when connected in series, after a reading when connected in parallel with the coil, indicates that the coil is open and should be replaced.

Caution: In the case of a coil rated 190 to 253 volts, make the connections with the circuit disconnected from the power supply.

(2) When readjusting or when checking for any electrical requirement except the check of operation discussed in (1), the relay should be disconnected from the working circuit if practicable. (Refer to 1.10.)

3.11 ***Time-Delay Interval Adjustment*** (Reqt 2.11)

(1) If the motor which is connected to the starter is in satisfactory condition but fails to start or comes up to speed too slowly, change the taps on the autotransformers to increase the starting voltage. If the fuses blow or there is other evidence of excessive starting current, change the taps to decrease the voltage.

(2) The taps in the newer starters are marked in per cent of line voltage. See that the taps are properly insulated with tape after any work has been done on them.

Caution: To avoid shock, do not touch parts which are at different potentials, and do not work with tools while the starter is connected to the power service.

(3) When determining the setting of the delay relay, it is necessary to first obtain an initial value which meets the requirement at the line voltage existing at the time, and then to increase this to obtain a final value such as will insure that, when started at the lowest voltage likely to be encountered at the office, the motor will attain the required speed before being transferred to the line.

(4) When determining the initial setting, start with a value which may prove to be longer than required and reduce it in steps of 1, 2, or 5 seconds. Start the motor on each setting observing the voltage until the motor shows a tendency to jump when transferred from the starting taps to the line. Then increase the relay timing until the motor transfers smoothly. This gives the initial setting.

(5) To obtain the final setting in an office having power service voltage limits not exceeding ±5 per cent, increase the setting by an amount depending upon the voltage observed during the foregoing procedure, as outlined below.

OBSERVED VOLTAGE	PER CENT INCREASE
Near low limit	None
Near average	20
Near high limit	40

In an office having power service voltage limits of ±10 per cent, proceed as outlined below.

OBSERVED VOLTAGE	PER CENT INCREASE
Near low limit	None
About 5 per cent low	20
Near average	40
About 5 per cent high	60
Near high limit	80

For example, if the initial setting is found to be 10 seconds at 250 volts and the office limits are 230 ±10 per cent (207 to 253 volts) the setting should be increased by 80 per cent of 10 seconds, namely 8 seconds. The final setting then becomes 18 seconds.

3.12 ***Temperature*** (Reqt 2.12)

(1) If the temperature exceeds the specified limits and the other requirements are met, refer the matter to the supervisor.